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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003900267 for a patent by SCALZO AUTOMOTIVE RESEARCH P/L as filed on 22 January 2003.

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Twentieth day of January 2004

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VARIABLE DISPLACEMENT PISTON ENGINE.

This invention relates to variable displacement or stroke, internal combustion engines and more particularly to an arrangement having efficient power-transmitting for stroke varying mechanism whereby the displacement of the pistons is varied by the piston stroke.

These types of stroke varying mechanisms are known to contribute substantial fuel economy improvements during part load operation.

Conventional internal combustion engines (ICE) are generally configured in an in-line, horizontally opposed or in a V formation. In a vehicle installation they are sized in volumetric capacity to achieve the desired maximum speed and acceleration requirements. This engine size generally means that at low load conditions, deceleration and braking periods, which is majority of the time, the fuel consumption is high because the engine needs to be throttled.

Many attempts have been made to reduce the capacity of the engine during low load conditions by variable stroke mechanisms, and cutting off fuel to some of the cylinders, however, most have not been successful. In the case of shutting off fuel to some of the cylinders, this method has produced some improvements but because the pistons are still moving, thus creating friction, the maximum benefits have not been derived.

It is the object of this invention to present an improved mechanisms for varying the stroke of each piston in a multi-cylinder engine either in an in-line configuration or in a V configuration. The stroke of each piston can be adjusted individually or in groups at a very fast rate as demanded by the vehicle via sensors and an engine management

system. In addition, the geometry of the link mechanism can be adjusted to allow for either, a nearly constant compression ratio or a variable compression ratio between its two extremes. Furthermore, the engine can be operated to switch between its two extreme stroke positions allowing high compression ratio at its minimum stroke position, and low compression ratio at the maximum stroke position allowing a turbo-charger or supercharger to further enhance the power range of the engine.

These features and advantages of the invention will be more fully understood from the following description of a preferred embodiment taken together with the accompanying drawings.

In the drawings:

Figure 1 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the maximum displacement condition with the piston approximately at the mid-stroke position.

Figure 2 is a horizontal partly cross sectional view of the various components in the drive train excluding the adjusting ram for clarity, through Section A-A.

Figure 3 is a transverse cross sectional view of one piston/crank assembly of a multi-piston engine, in the minimum displacement condition with the piston approximately at the mid-stroke position.

Referring to Figs. 1 and 2 of the drawings, an internal combustion engine 10 having a cylinder block 12 defining one of many cylinder bores 14. The cylinders 14 are closed at one end by a cylinder head which is provided with the usual inlet and exhaust port, valves, actuating gear and ignition means, none of which are shown.

Piston assembly 16 moves in bore 14 and connects to the rocking member 18 via connecting rod 20 and forked link 22. Connecting rod 20 is pivotally connected to the piston 16 via gudgeon pin 24, and pivotally connected to the forked link 22 via pin 26. The other end of the forked link 22 is pivotally linked to the rocking member 18 by pin 28 fixed on either side of the rocking member 18. The axes of pins 24, 26 and 28 are parallel to each other. Rocking member 18 is pivotally supported within the engine block 12 on support pins 30 and 32 on respective bearings 34 and 36, with the axis also parallel with pins 24, 26 and 28.

The rocking member 18 connects to the crankshaft 38 via connecting rod 40, pin 42, fixed at either end to the rocking member 18, and crankpin 44. The position of pin 42 can be placed in a suitable radial position on the rocking member 18 to transmit the oscillating motion to the crankshaft 38. Thus the linear piston 16 motion is transferred to the crankshaft 38 via connecting rod 20, forked link 22, rocking member 18 oscillating on support pins 30 and 32, and connecting rod 40.

The geometry of the linkage system as represented in Fig. 1 shows the engine 10 in the maximum displacement position with the piston 16 at approximately mid-stroke. The connection at pin 26 by connecting rod 20 and forked link 22 is held in position against a stop 46 fixed in rocking member 18 and a corresponding face 48 on forked link 22, by a double acting hydraulic ram 50 with its two ends pivotally connected at a suitable position 52 on the rocking member 18, and at position 54 on the forked link 18. The hydraulic ram 50, not fully detailed, is a standard component allowing hydraulic fluid under pressure, and via external valving, to push or retract its internal piston within its extremities. At the maximum stroke position the ram 50 is fully extended.

The stroke of piston 16, represented by linear movement B, is determined by the corresponding linear movement component C of pin 26, as it swings through arc D. For the minimum stroke position, reference is made to Fig. 3 in which the piston of the hydraulic ram 50 is fully retracted pulling forked link 22 against stop 56 of rocking member 18 against a corresponding face 58 on forked link 22 and pivoting on pin 28. The pivoting position of pin 28 and the length of forked link 22 describe an arc 60 for pin 22 between the maximum stroke position and minimum stroke position. Essentially, the piston 16 is always made to operate from the top of cylinder 14 plus allowance for compression ratio adjustments. The arc 60 is to be kept as flat as possible to minimise the effect of compression ratio variations between the two displacement extremes. However, the shape of the compression ratio variations can be designed to allow for supercharging, thus producing a variable compression ratio.

In Fig. 3 the stroke of piston 16, represented by linear movement E, is determined by corresponding linear movement component F of pin 26 as it swings through an arc G. It is to be noted that the arcs D and G swing through the same angle determined by the position of pin 42, pivotally on rocking member 18, and the throw of crankshaft 38. It is to be understood that the variable displacement engine 10 can be operated under various conditions, for example:

In one embodiment the engine can be operated as a two position capacity engine having two displacement positions only, minimum and maximum, with either the same compression ratio or different compression ratios to allow turbo or super-charging at the maximum displacement position.

In a second embodiment the engine can be operated as a variable capacity engine throughout its variable range by controlling the position of the hydraulic ram 5. A pre-determined compression ratio curve can be applied.

In a third embodiment each piston assembly of a multi cylinder engine, can be operated independently to achieve greater variability of displacement.

In a fourth embodiment the mechanism can be applied to horizontally opposed engine, V-engines as well as in-line engines.

The scope of the invention need not be limited to the mechanism shown, Variations in the positioning of the crankshaft and the rocking member and the method of altering the position of the linkages, either by hydraulic or mechanical systems, and in addition, the geometry of the linkages to achieve the same outcome, fall within this invention.

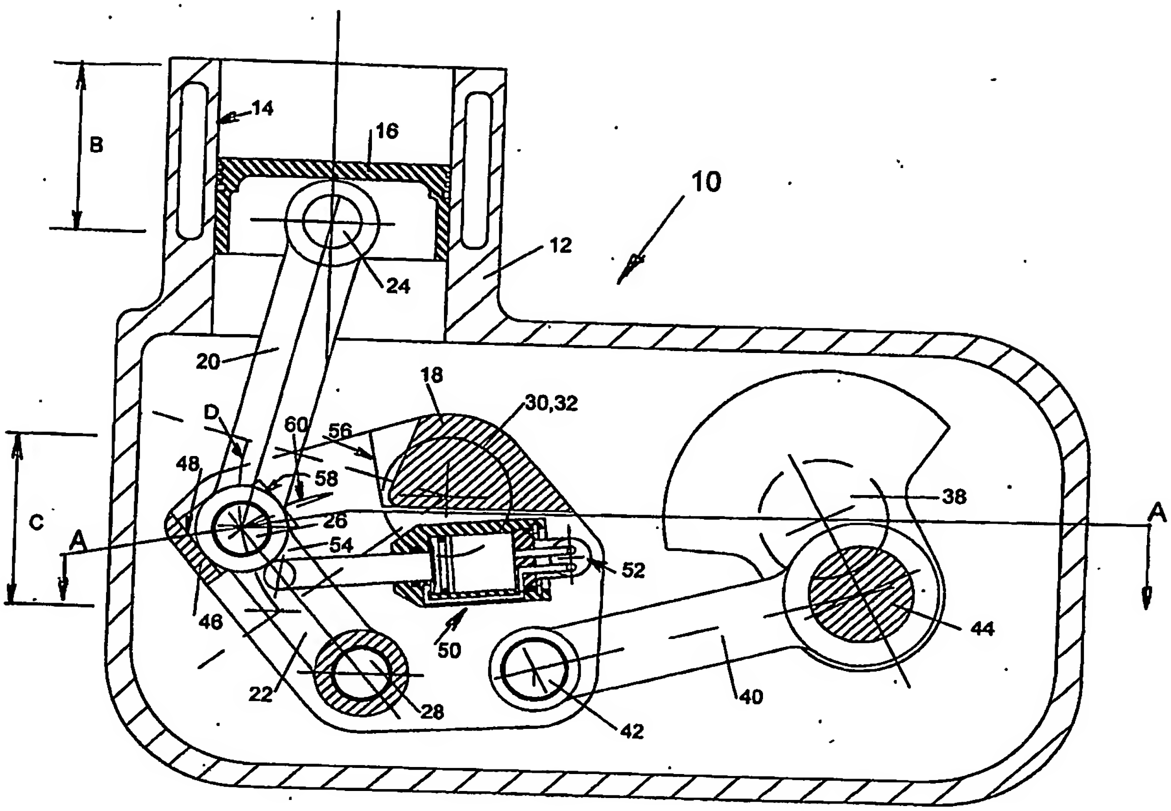
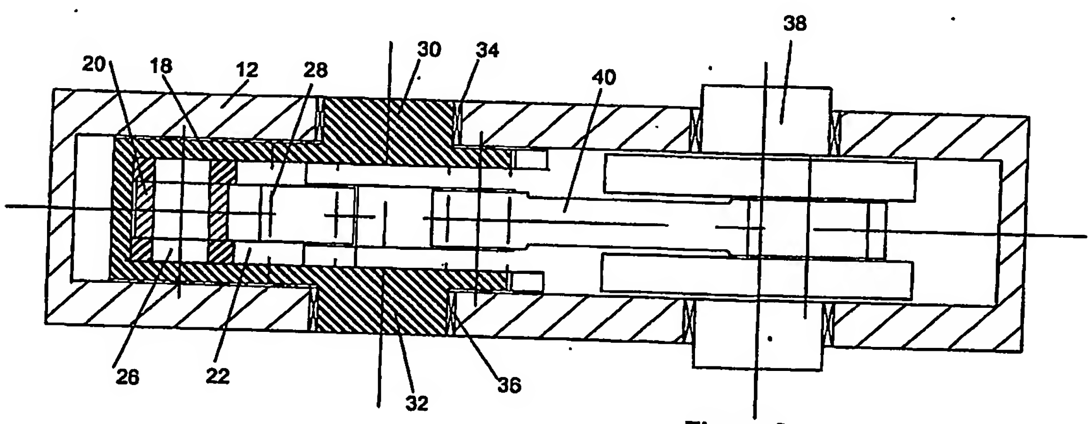


Figure 1



Section A-A

Figure 2

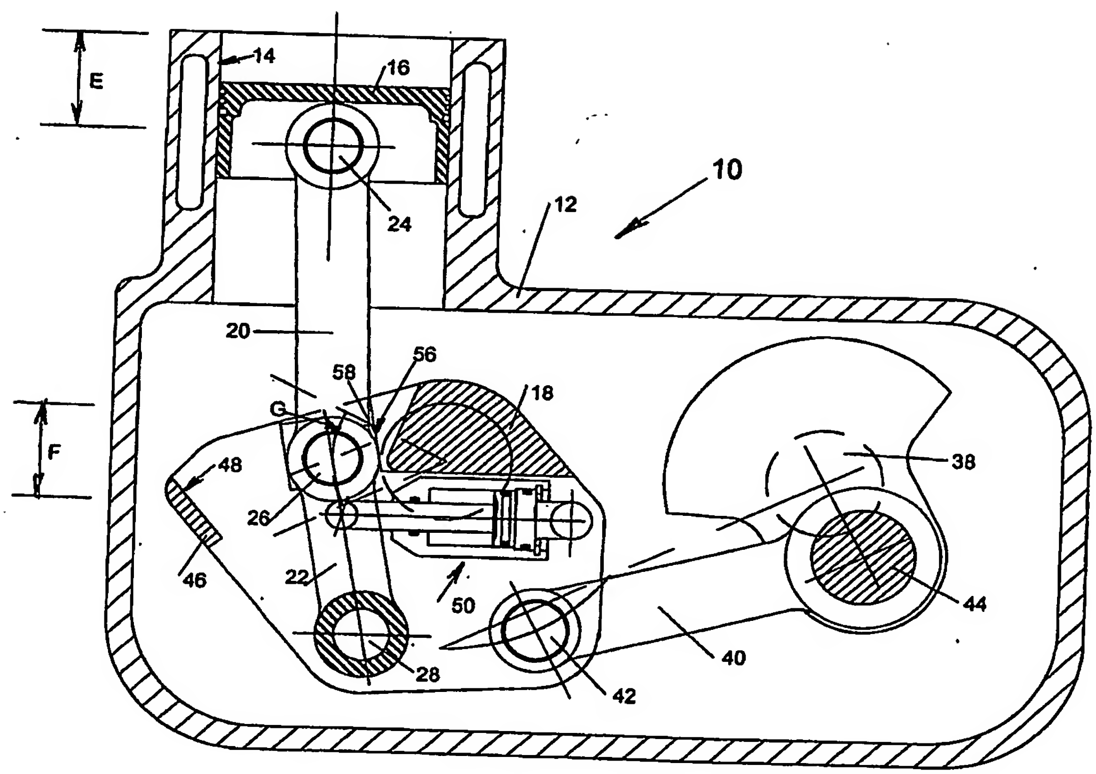


Figure 3